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AGE AND GROWTH OF *CAPOETA TRUTTA* (PISCES: CYPRINIDAE) FROM KEBAN DAM LAKE, TURKEY

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ABSTRACT. In this study the ages of *Capoeta trutta* (Heckel 1843) inhabiting Keban Dam Lake were determined from scales. The mean fork lengths determined using the back-calculation method were $l_1=70.59$, $l_2=119.37$, $l_3=167.53$, $l_4=195.97$, $l_5=221.03$, $l_6=250.52$, $l_7=274.63$ and $l_8=300.38$ mm for males, $l_1=68.87$, $l_2=117.03$, $l_3=166.34$, $l_4=203.91$, $l_5=230.17$, $l_6=248.20$, $l_7=267.98$ and $l_8=294.69$ mm for females, $l_1=63.45$, $l_2=105.92$, $l_3=151.54$, $l_4=188.20$, $l_5=212.33$, $l_6=245.05$, $l_7=270.85$ and $l_8=295.97$ mm for all fish samples. The calculated length of any of the age groups was always smaller than the real length measured for the same age group. The gap between calculated and measured lengths increased when the scales of older fish were used in the calculations.

Key words: AGE DETERMINATION, BACK-CALCULATION METHOD, *CAPOETA TRUTTA*, KEBAN DAM LAKE

INTRODUCTION

General information on age determination and the growth characteristics of fish were published in Lagler 1956, Chugunova 1963, Tesch 1968, Summerfelt and Hall 1987, Çelikkale 1991, Erkoyuncu 1995, Geldiay and Balık 1996 and Aşar 1998.

Many studies were also conducted on the biological characteristics and growth of the economically important cyprinid, *Capoeta trutta* (Heckel 1843), which inhabits the Keban Dam Lake of Turkey (Özdemir and Şen 1983, Polat 1987, Ünlü 1991, Şevik 1993, Gül et al. 1996, Öztürk et al. 1997). However, no study focused on estimating the length growth of this species in its previous years of life. Thus, the aim of this study was to determine the previous length growth of *Capoeta trutta* (Heckel 1843) from scales using the back-calculation method.

STUDY AREA

Keban Dam Lake was built on the Euphrates River in the eastern part of Turkey and is the second largest artificial lake in the country. It is 845 m above sea level and has a surface area of 675 km² at maximum level. Its maximum depth is 160 m and its catchment area is 64100 km² (Fig. 1).



Fig. 1. Map of Keban Dam Lake (modified from Çalta and Canpolat 2002).

MATERIAL AND METHODS

A total of 228 fish samples were caught monthly in Keban Dam Lake from January 1997 to December 1998 for the purposes of this study. In order to obtain fish samples of various sizes, trammel nets with 18, 28, 36 and 44 mm mesh sizes were used in the catches.

The fork length of the fish was measured to the nearest 1 mm. Then, at least 10 scales from each fish were taken from under the anterior part of the dorsal fin (Lagler 1956). The scales were prepared for examination after being cleaned and dried (Chugunova 1963). The number of annuli and the radius of each annulus were determined under a binocular microscope with a micrometer. In order to determine age, the scales were read several times by three technicians independently. The readings which were repeated most frequently for each scale were accepted as the age of the fish. The scale radius was measured on the caudal field of the scale. The lengths at the previous ages of the fish were estimated by the following back-calculation method (Chugunova 1963):

$$L_n = \frac{S_n}{S} (L - a) + a$$

where, L_n - length of fish when annulus 'n' was formed

L - length of fish at time scale sample was obtained

S_n - radius of annulus 'n' at length ' L_n '

S - total scale radius

a - constant value obtained from graph between fork length and scale length of fish.

RESULTS AND DISCUSSION

A total of 228 *Capoeta trutta* (Pisces: Cyprinidae) from Keban Dam Lake in Turkey were examined for this study. The age of the fish samples were determined from scales. Various studies have been done on age determination in *Capoeta trutta* using different bony structures (Özdemir and Şen 1983, Öztürk et al. 1997). Özdemir and Şen (1983) observed that in *Capoeta trutta* the annuli on scales were better than those on the otolith and operculum. Öztürk et al. (1997) also identified rather clear annuli on scales, although the best were noted on the dorsal fin radius. Both of these studies recommended using scales for age determination in this species because of advantages such as easy collection, preparation and the rather clear scale annuli. A linear relationship was determined between the fork length and the scale length of fish (Fig. 2). The "a" value obtained in Figure 2 was 12 mm, which indicates that the first scale formation started while the fish were 12 mm long. Estimating the previous length growth of the *C. trutta* population in Keban Dam Lake was determined using the back-calculation method. The results are presented in Table 1. The mean calculated fork length values were between 70.59 - 300.38 mm for males, 68.87 - 294.69 mm for females and 63.45 - 295.97 mm for all fish samples.

TABLE 1

Calculated fork length values (mm) for males, females and all fish samples according to age groups

Age groups	Fish number	Males							
		l ₁	l ₂	l ₃	L ₄	l ₅	l ₆	l ₇	l ₈
III	26	85.51	147.53	199.66					
IV	21	69.63	117.58	170.18	220.29				
V	9	68.03	111.75	160.18	203.03	248.65			
VI	8	58.65	97.41	139.84	182.18	225.47	267.50		
VII	8	52.45	85.72	123.95	161.94	203.17	244.85	280.67	
VIII	5	49.74	83.17	116.59	157.63	192.79	232.44	264.98	300.38
Mean values		70.59	119.37	167.53	195.97	221.03	250.52	274.63	300.38
SD		16.95	29.72	35.69	32.36	28.95	21.84	16.65	20.61
Anova		***	***	***	***	***	**	NS	
Females									
III	44	76.16	130.23	183.02					
IV	47	72.50	121.48	174.00	222.02				
V	28	64.59	111.72	159.40	206.56	249.92			
VI	16	60.45	104.21	146.77	186.28	221.66	262.98		
VII	12	54.26	91.81	131.11	165.71	204.51	233.57	269.57	
VIII	4	53.61	83.57	125.43	157.75	203.03	232.96	262.97	294.69
Mean values		68.87	117.03	166.34	203.91	230.17	248.20	267.98	294.69
SD		17.62	26.29	29.58	31.93	30.70	27.27	19.32	28.52
Anova		***	***	***	***	***	**	NS	
All fish samples									
III	70	79.63	136.65	189.19					
IV	68	71.66	120.27	172.82	221.48				
V	37	65.43	111.73	159.59	205.70	249.61			
VI	24	59.85	101.95	144.46	184.92	222.93	264.49		
VII	20	53.54	89.37	128.25	164.21	203.97	238.09	274.06	
VIII	9	51.46	83.35	120.52	157.69	197.35	232.67	264.09	297.85
Mean values		69.45	117.82	166.74	201.35	227.12	249.12	270.96	297.85
SD		17.38	27.46	31.70	32.18	30.28	25.06	18.17	22.94
Anova		***	***	***	***	***	***	NS	

Key: NS (not significant) $P > 0.05$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Significance levels among the lengths calculated from different age groups were found to be statistically significant for l₁-l₅ ($P < 0.001$) and for l₆ ($P < 0.01$) in males and females, respectively, and for l₁-l₆ ($P < 0.001$) in all fish samples, but they were not significant for l₇ in males, females and all fish samples (Table 1).

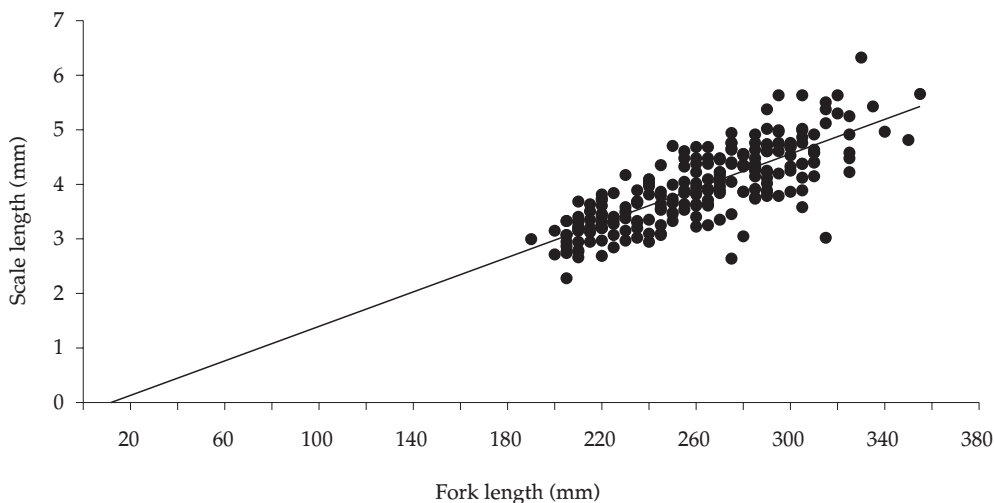


Fig. 2. Relationships between body and scale length of *C. trutta* (Heckel 1843) inhabiting Keban Dam Lake.

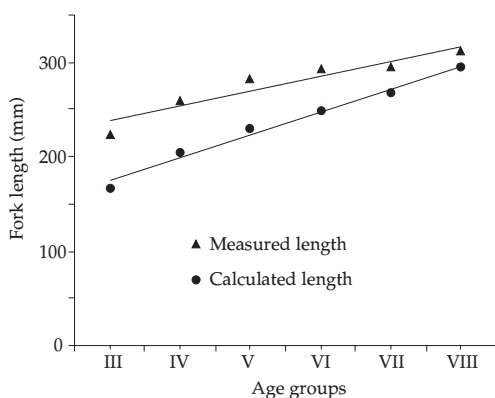


Fig. 3. Relationship between measured and calculated fork lengths of *C. trutta* for males.

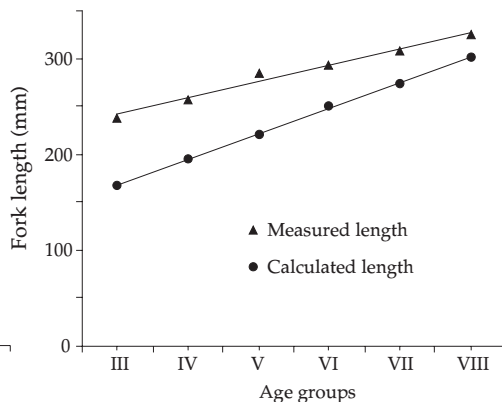


Fig. 4. Relationship between measured and calculated fork lengths of *C. trutta* for females.

In all age groups, the calculated fork lengths were always smaller than the measured fork length and were increasingly closer to the measured lengths as fish age increased (Figs. 3-5).

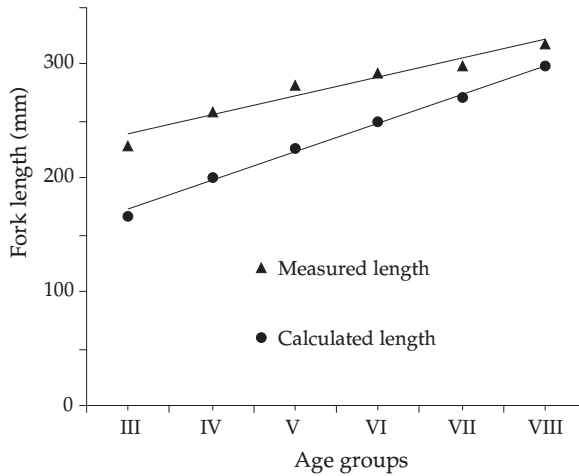


Fig. 5. Relationship between measured and calculated fork lengths of *C. trutta* for all fish samples.

The calculated results from the present study were also compared with the measured results of other studies of the same species (Özdemir and Şen 1983, Polat 1987, Ünlü 1991, Şevik 1993, Gül et al. 1996, Öztürk et al. 1997). The calculated lengths from the present study were smaller than the measured lengths for the same age groups in those studies. Erkoyuncu (1995) suggested that the calculated length of a young fish is always smaller than the real length and that the gap between the calculated length and the real length of fish increase when the scales of older fish are used in the calculations. The calculated fork length of an age group decreased as the age of the fish used in the calculation increased. Similar results were observed in the present study (see Figs. 3-5).

In conclusion, although no fish samples from the I and II age groups were studied, the body lengths of these age groups were estimated using back-calculation. This finding shows that the most important advantage of the back-calculation method is that it is possible to estimate the length of fish from young age groups that cannot normally be sampled. This method is very useful in obtaining information about the length growth features during the earlier life stages of fish.

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STRESZCZENIE

WIEK I WZROST *CAPOETA TRUTTA* ZE ZBIORNIKA KEBAN, TURCJA

Celem badań było określenie wieku gatunku ryb karpiowatych, *Capoeta trutta* (Heckel 1843) zamieszkującego zbiornik Keban (Turcja) na podstawie łusek (rys. 1 i 2). Średnia długość ogonowa, określona na podstawie metody odczytów wstecznych, wynosiła: $l_1=70,59$, $l_2=119,37$, $l_3=167,53$, $l_4=195,97$, $l_5=221,03$, $l_6=250,52$, $l_7=274,63$, $l_8=300,38$ mm dla samców; $l_1=68,87$, $l_2=117,03$, $l_3=166,34$, $l_4=203,91$, $l_5=230,17$, $l_6=248,20$, $l_7=267,98$, $l_8=294,69$ mm dla samic; $l_1=63,45$, $l_2=105,92$, $l_3=151,54$, $l_4=188,20$, $l_5=212,33$, $l_6=245,05$, $l_7=270,85$, $l_8=295,97$ mm dla całej grupy ryb (tab. 1, rys. 3, 4, 5). Długość ryb, w przypadku każdej grupy wiekowej, określona na podstawie odczytów wstecznych była zawsze mniejsza od rozmiarów rzeczywistych. Różnica ta wzrastała, gdy do obliczeń używano łusek od starszych osobników.

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